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Sports Nutrition Principles for Training and Recovery:

Strategies to Optimize Performance

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Learning Objectives

Participants will be able to:

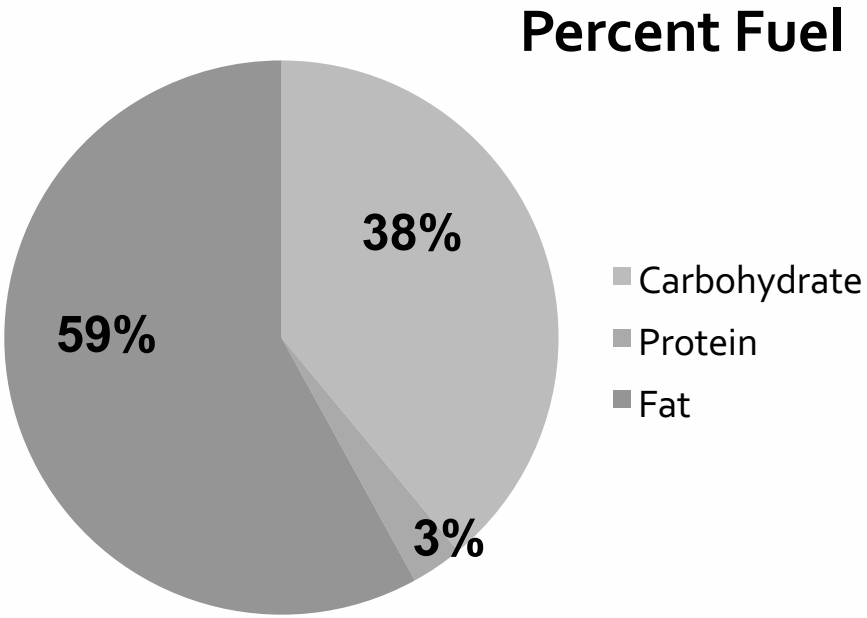
- Describe at least three principles of nutritional periodization for macronutrients for the athlete.
- Describe at least three fundamentals of daily hydration and fueling for training and competition for athletes.
- Outline at least two pre-exercise foods, at least two fluid choices designed to improve performance.
- List at least three essential components of recovery nutrition.
- List at least three key nutritional components for muscle building.

Training diet components

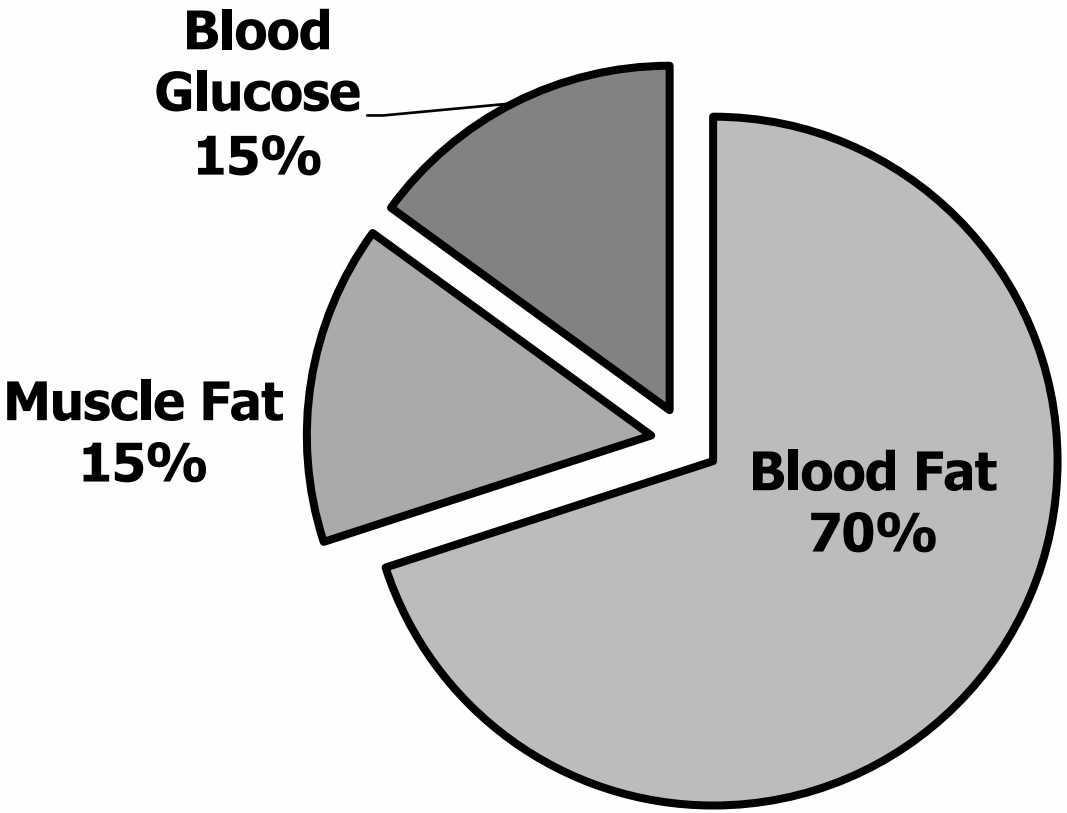
- Carbohydrate fuel targets
- Integrated recovery nutrition
- Fuel, fluid, and electrolyte replacement
- Pre-exercise/competition nutrition window
- Daily protein requirements
- Fat intake

What fuels are used during exercise?

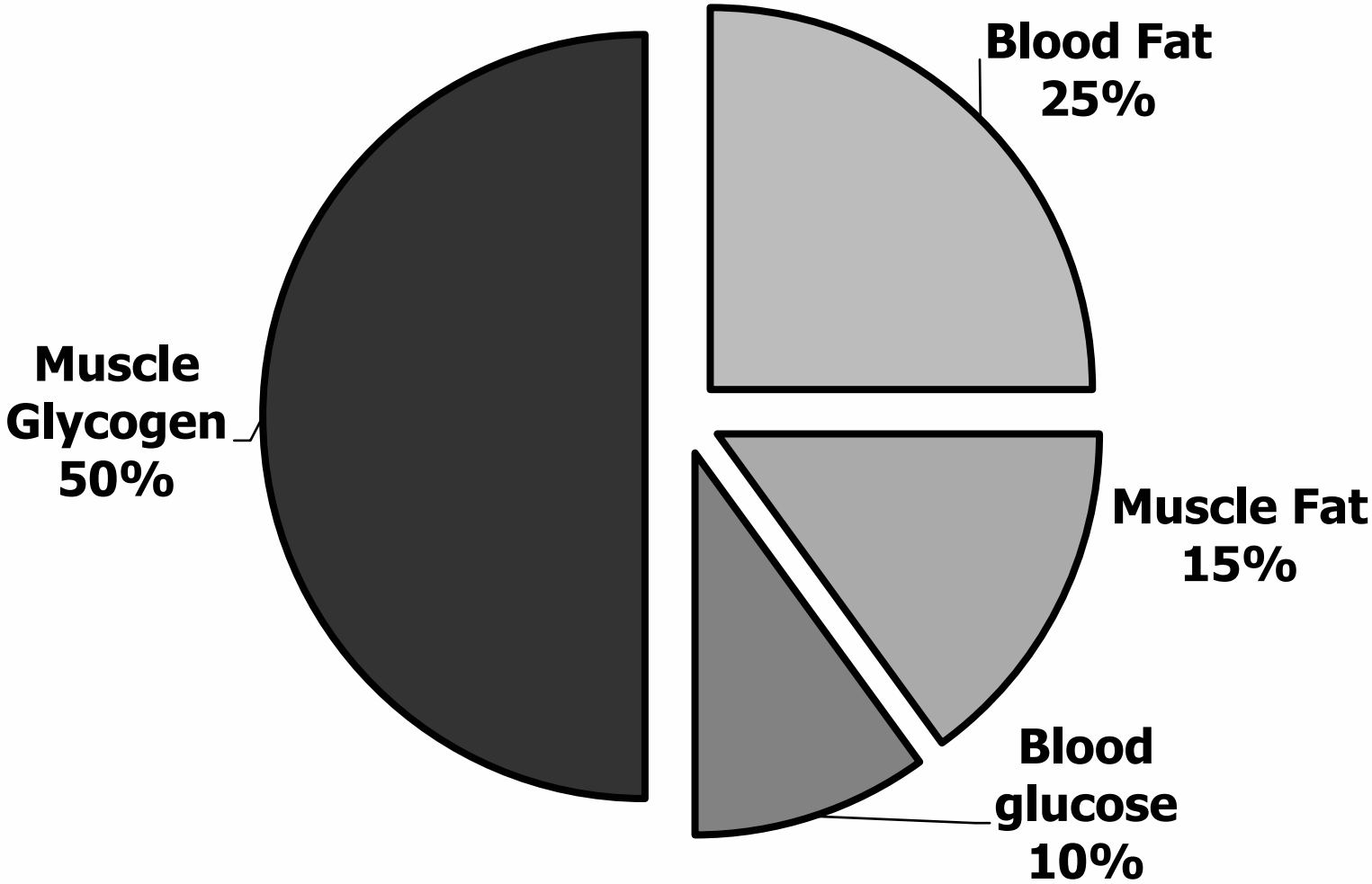
FUEL SOURCES AT REST



Fuel sources at 25% VO2 Max



Fuel sources at 60% VO2 Max



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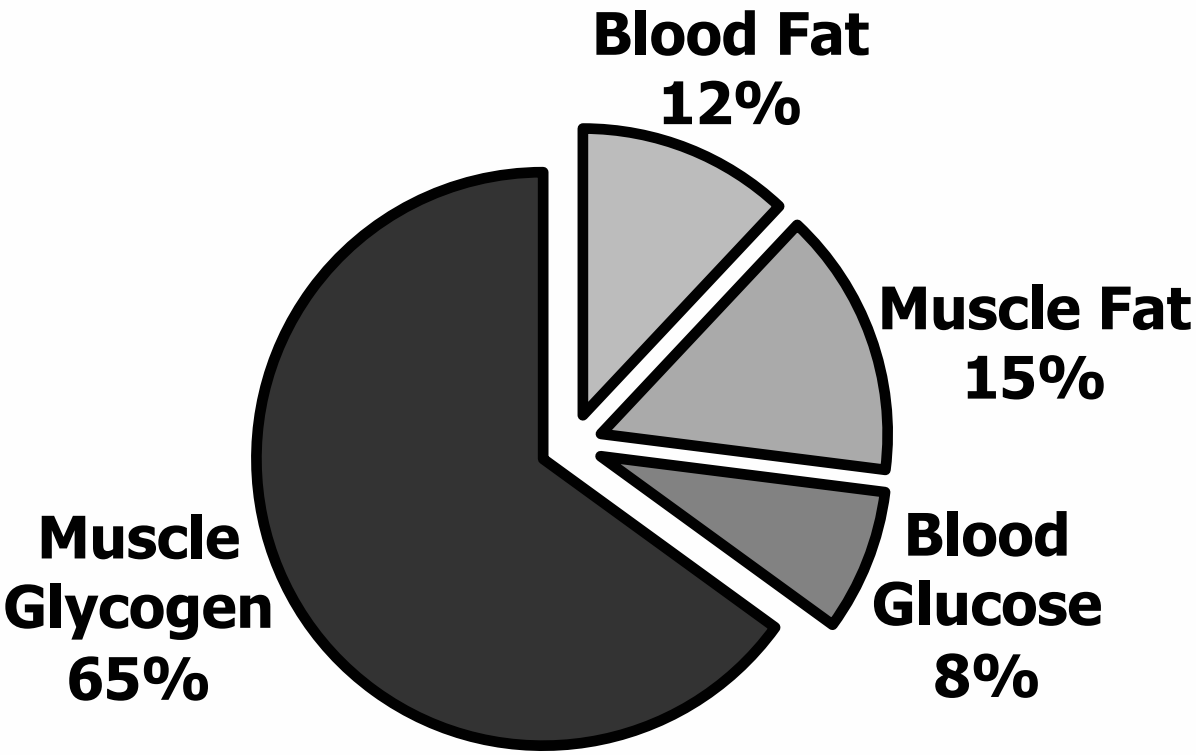
Fuel sources at 85% VO2 Max



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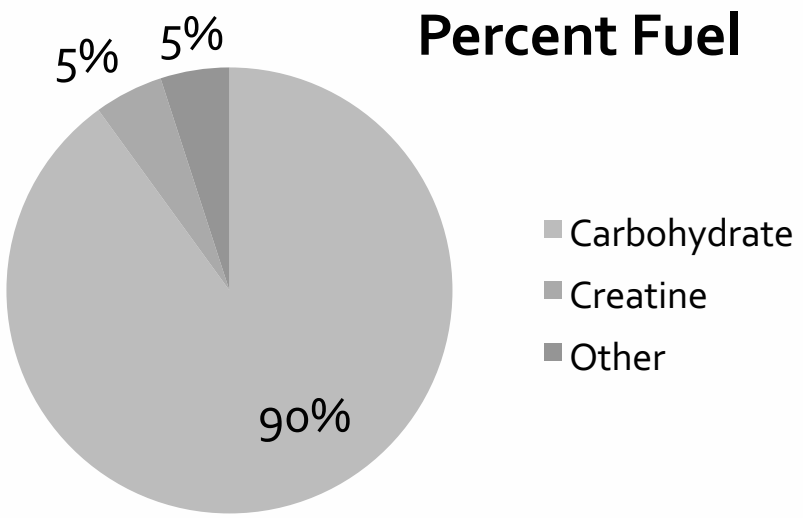
What fuels are used during exercise?

Fuel source during resistance training



Carbohydrate availability and training

Strategies and outcomes

Carbohydrate targets

- When it is important to train hard or at high intensity, daily carbohydrate intakes should match the fuel needs of training and glycogen restoration.
- Focus on high carbohydrate availability for training and recovery

Daily carbohydrate targets

Training	Carbohydrate Requirements
Easy training/Energy restriction	3-5 g/kg body mass/d
Moderate Training: 1 hour/day	5-7 g/kg
Endurance: 1-3 hour day at moderate/high intensity	6-10 g/kg
Extreme endurance: >4-5 hour day at moderate/high intensity	8-12 g/kg

IOC Nutrition Guidelines
Burke, LM et al. J Sports Sci, 29: sup1, S17-27

These are estimates
-Need to be individualized
-Periodize from day to day

Higher carbohydrate intake

- 10 well-trained runners increased training by 150% for 5 days
- Consumed either 8g/kg or 4 g/kg carbohydrate daily
- Both diets: gradual decline muscle glycogen over the week
- Fuel stores better preserved on high CHO diet
- Treadmill test: reduced running economy at two different speeds with moderate-CHO diet versus high-CHO diet

Kirwan et al. 1988. *Journal of Applied Physiology* 65: 2601-2606.

Higher carbohydrate intake

- Compared diet of 5.4 to 8.5 g/kg CHO, each
- (41 vs 65% total energy intake)

- 11 day trial" 4 days training + 7 days intensified training
- Days 1, 5, 8, 11: 30 min steady state running at 57% VO2 max,+ 8 km lab time trial
- Days 6, 7, 9, 10: 16 km running field time trial

- Higher CHO diet:
  - Maintained a higher running speed for both trials
  - Better mood state and less symptoms of over-reaching

Achten, J. et al. 2004, *Journal of Applied Phyisiology 96: 1331-1340.*

Carbohydrate targets

- Specific to each training day
- Includes carbohydrates consumed before-during-after training
- Nutrition plan needs to consider 2-a-days
- Timing of training session- time between sessions
- Nature next day's training session

Optimal Foods and Fluids for……

After-
Jump start recovery

During-
Provide training fuel and practice competition day strategies

Before-
Provide training fuel and learn specific tolerances

Purpose of recovery nutrition

- Rehydration
- Replenishment of electrolytes
- Restoration muscle glycogen
- Restore liver glycogen
- Replenishment muscle triglycerides
- Repair muscle damage and build protein stores

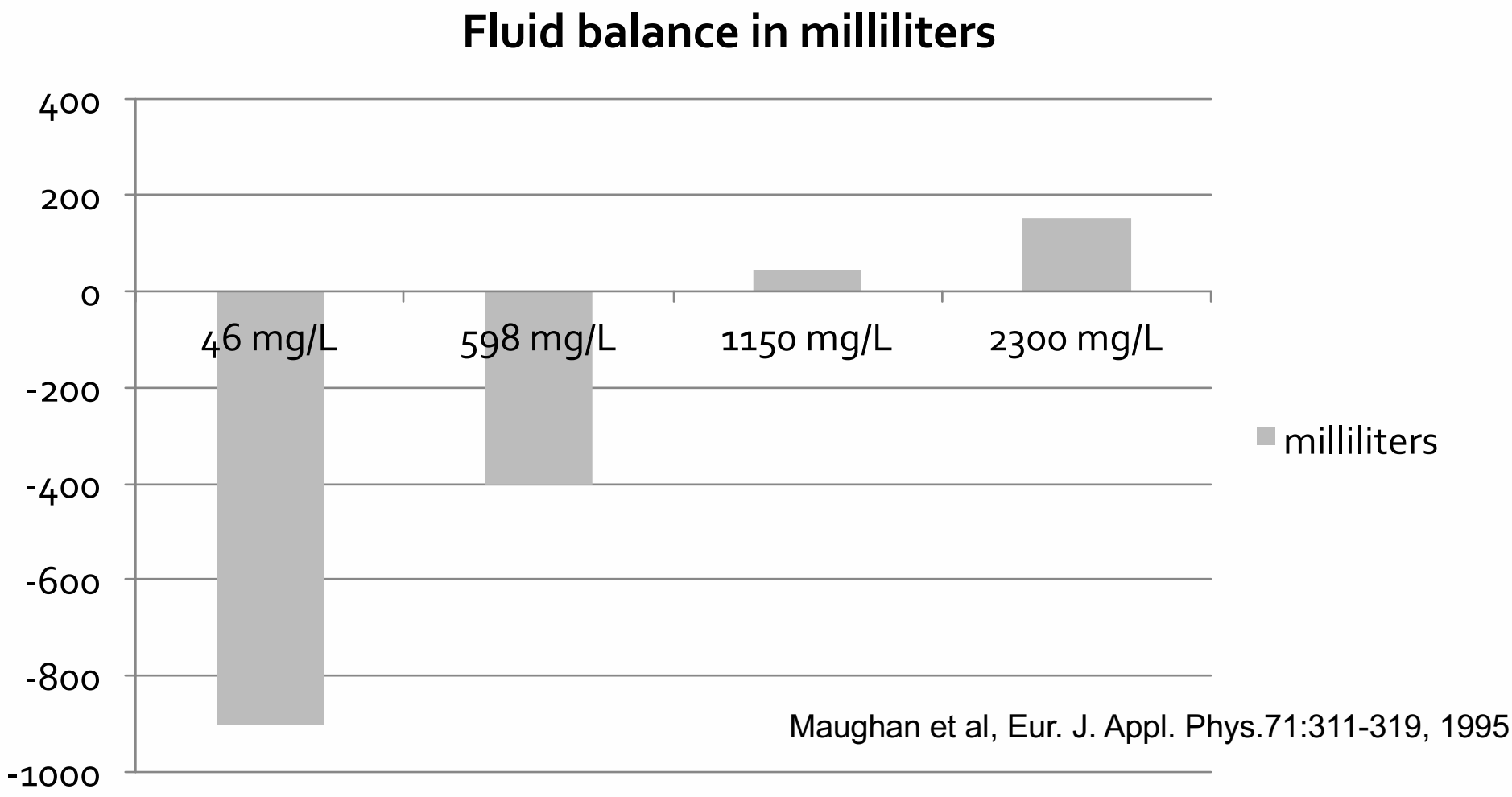
Speedy refueling needed when:

- Less than 8 hours recovery between two demanding training sessions

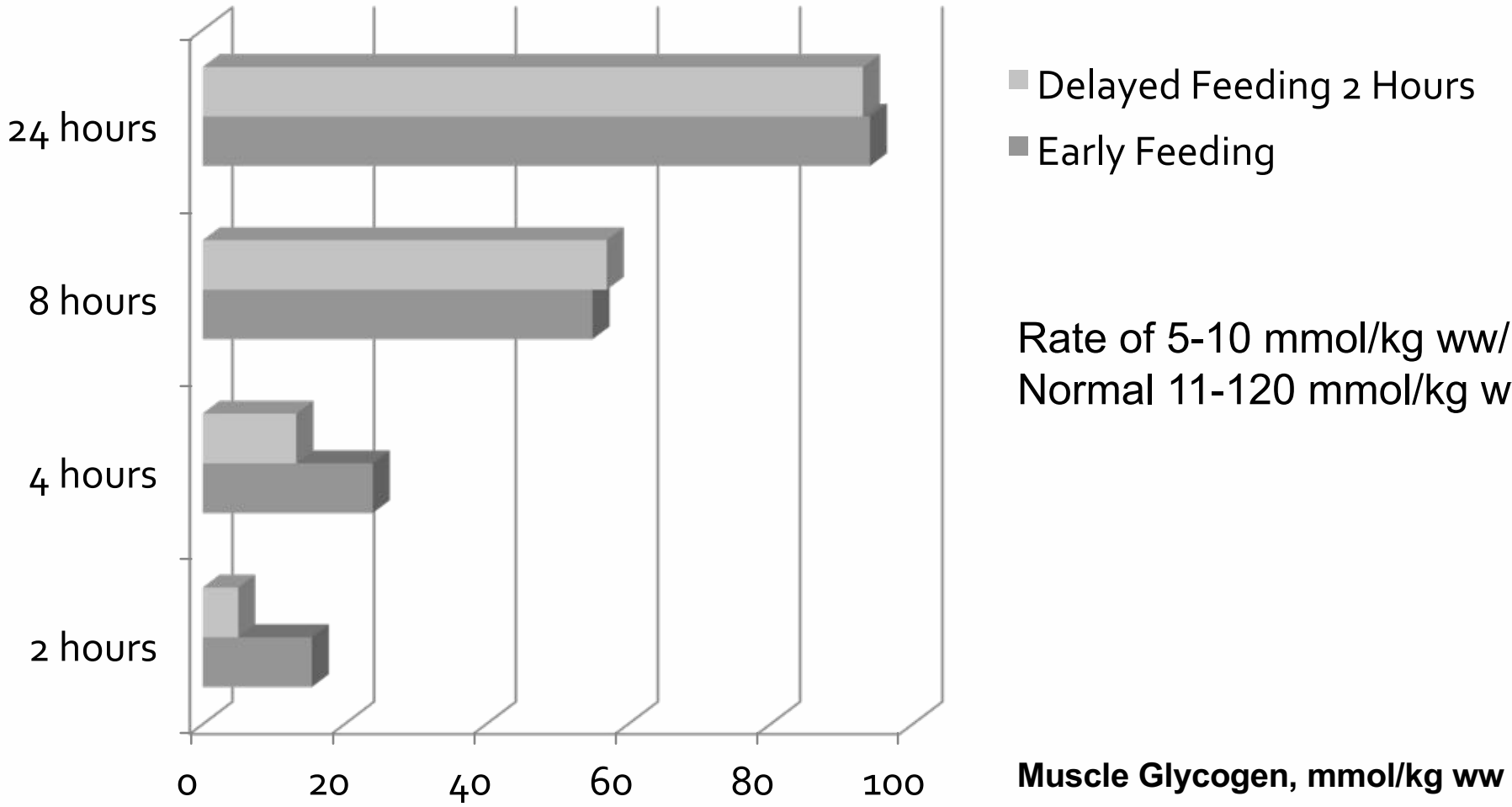
Rehydration

- Every 1 kg (2 lb) weight loss requires intake of 1500 ml fluid over the next 2-4 hours
- Cold drinks help reduce core temperature after hot workout
- Carbohydrate containing drinks provide fuel
- Sodium will speed up rehydration and decrease urine production
  - Salty foods and high sodium recovery drinks

Adding sodium to rehydration drinks: fluid balance



Delayed feeding vs. early feeding



Rate of 5-10 mmol/kg ww/hr
Normal 11-120 mmol/kg ww

Burke, Keins, Ivy, 2004 J. Sport Sci 24: 675-685

Restoring muscle glycogen

Biphasic response

- Rapid early phase 30-60 min
  - Non-insulin dependent
- Slow phase lasting 24+ hours
  - Insulin dependent

- Restoration muscle glycogen takes priority over liver glycogen and even occurs in absence CHO intake through gluconeogenesis

Recovery

- The lower the glycogen stores the faster the rate of recovery
- Focus on high glycemic index (GI) carbohydrate foods immediate post
- Regular CHO feedings 4-6 hours
- Moderate + high GI meals promote greater glycogen storage than low GI meals
- Fluid or solid- not a factor

Recovery

- Both rapid recovery both muscle and liver glycogen- consider fructose or sucrose as well
  - Rate of processing ingested glucose limited
  - Adding fructose increases the total capacity to absorb carbohydrates
    - Greater rate liver glycogen repletion
    - Can help minimize GI distress after exercise
    - Use when consuming >1g/kg every 1-2 hours after exercise

Gonzalez, JT et al. 2017 Nutrients (9) 344: 1-15

Trommelen, J et al. MSSE. 2016 48(5): 907-12

Add protein?

- Protein added to sub-optimal carbohydrate in early recovery can enhance glycogen storage
- 9 studies: some controlled for CHO and calories; other did not
- Optimal amount 0.3 g/kg or up to 20-25 g

Betts and Williams, Sports Med, 2010; 40, 941-959

Integrated recovery

Endurance

- >1 g/kg carbohydrate immediately post
  - Count towards daily carbohydrate target
  - Mix carbohydrates
- 10-25 g high quality protein if there has been muscle damage or if not enough carbohydrate is consumed
- Choices high in vitamins and minerals
  - Antioxidant rich foods
- Rehydration and electrolytes
  - 600-720 ml per 0.5 kg (1 lb) weight loss
  - 500 mg sodium

Immediate recovery foods

- Flavored low fat milk
- Liquid meal supplement
- Sports shake
- Homemade shake/smoothie
- High CHO supplement
- Sports drink

- Cereal, fruit, milk
- Sandwich with protein, pretzels, fruit
- Fruit flavored yogurt, cereal bar
- Baked potato with vegetable topping
- Bowl rice with strips protein
- Pasta salad mix

Fueling and Hydrating During Training

Carbohydrate during exercise

- Maintain high blood glucose levels
- Provide fuel sustain high rate CHO oxidation once muscle glycogen becomes depleted
- Spares liver glycogen
- Some studies (not all) show muscle glycogen sparing- may be confined to some muscle fibers
- Muscle glycogen resynthesis during intermittent high intensity exercise

The dose of carbohydrate matters

- 12 cyclists during 2 hour ride + 20 km TT
- Tested 15, 30, 60 g glucose per hour
- All doses improved performance
- The higher the dose the greater the improvement

Smith et al; 2010. Journal Applied Physiology 108 (6): 1520-1529.

Fuel during exercise

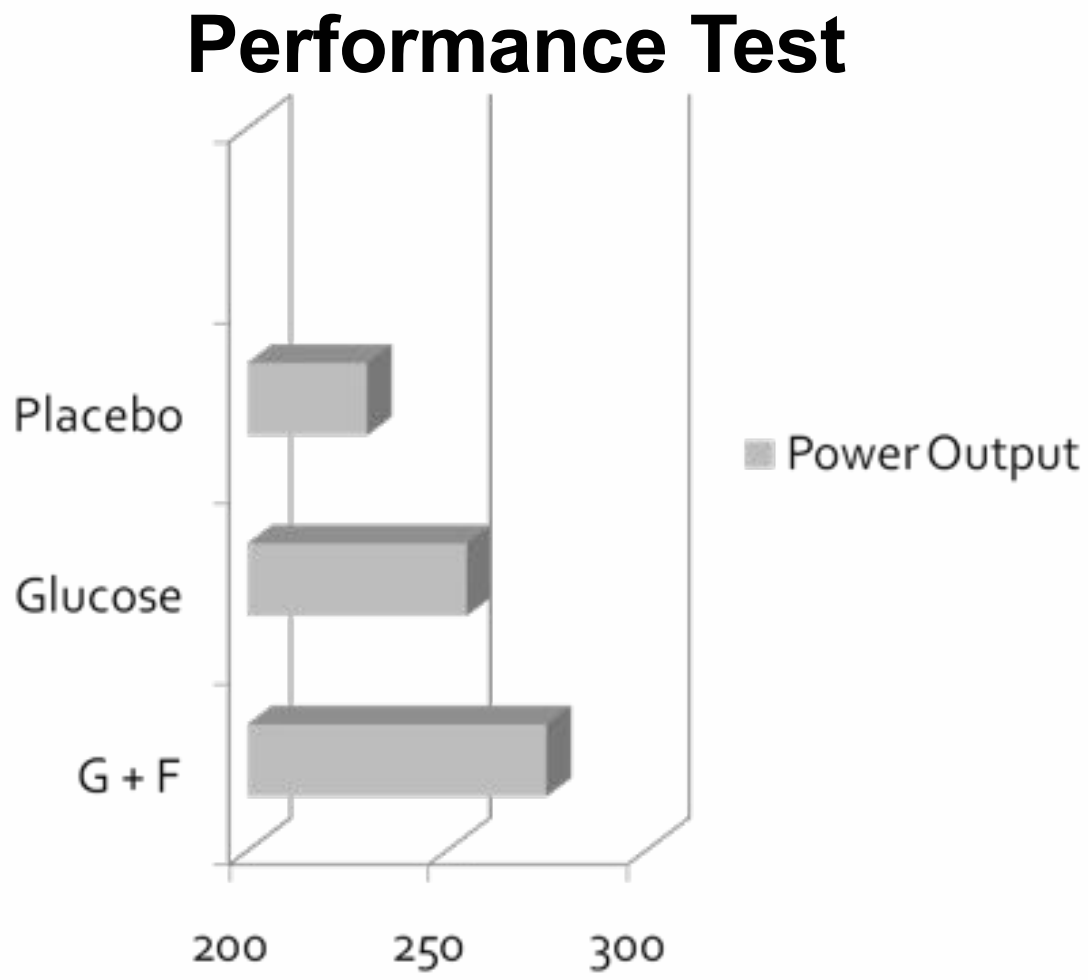
- Glucose only 1 g/per minute
  - maximal absorption: 60 g/hr
  - sodium dependent glucose transporter
    - SGLT1- brush border membrane
- Fructose
  - sodium independent transporter
    - GLUT5

Multiple carbohydrate sources

- Mix of glucose, fructose, or sucrose
  - increase absorption to 1.2 kg /min
    - >75 g/hr
  - Glucose + fructose mix or maltodextrin + fructose mix is best
  - Glucose (SGLT1)and fructose (GLT5) use different transporters to get across the small intestine- maximize absorptive capacity

Performance trial

- Glucose + fructose in 2:1 ratio ingested at rate 1.8 g/min
- 8% improvement in time trial performance over glucose alone
- Over 5 hr cycling: RPE lower, high cycling cadence



Currell, K and Jeukendrup, A, 2008. Med Sci Sport and Exercise 40 (2): 275-281

CHO ingestion rate and cycling TT performance

- 51 cyclists and triathletes
- 2 hr constant load ride + 20 km TT
- 12 beverages
  - Glucose:Fructose 2:1
  - CHO doses from 10 to 120 g per hour
  - Dose dependent performance improvement

- Greatest at 60 to 80 g per hour

Smith, J et al. MSSE, 2013, 45 (2): 336-341.

Multiple carbohydrates

- Glucose + Fructose
  - Higher rate gastric emptying
  - Fluid delivery improved
  - Greater oxidation efficiency (less residual in intestine)
  - Less GI distress at high CHO doses

Fueling options

- Energy bar vs CE drink
  - Cycled 60% VO2 max, 180 minutes
  - Both GLU + FRU
  - CHO burned at same rate

Pfeiffer, BT et al. 2010. *Med Sci Sport Exerc* 40(2): 2030-2037

- Gel vs CE Drink
  - Same protocol
  - Burned at similar rate

Pfeiffer, BT et al. 2010. *Med Sci Sport Exerc* 40(2): 2038-2045

Fueling options

Gel during
16 km run

- 84 g CHO per hour
- Glucose only
- Glucose + Fructose

- 10-20% had serious GI symptoms

Pfeiffer, BT 2009; Int J Sport Nutr Exerc Metab 19(5):485-503

Protein during exercise

- Research a mix
- Different protocols
  - Time trial versus endurance tests
    - Improve time to exhaustion-
      - ***no apparent mechanism***
    - Time Trial- no performance benefit protein
- Can include small amount protein before exercise and use for fuel- prevent muscle breakdown during endurance exercise?

Fueling strategies

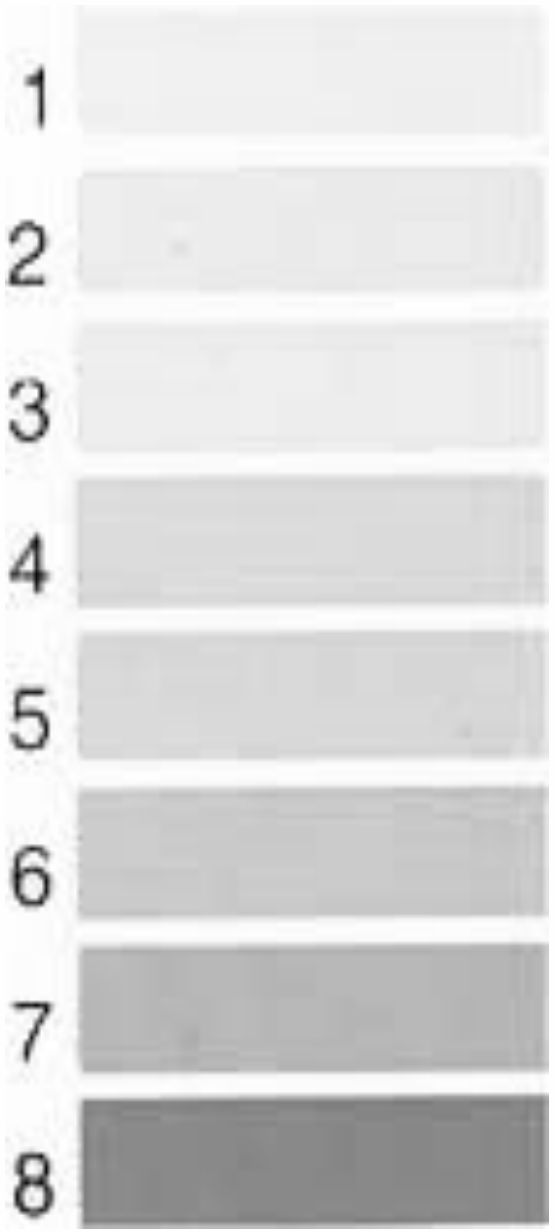
- Also require a balance between fluid and electrolyte requirements
  - What is the sweat rate?
  - What are energy requirements?
  - How well is the mix tolerated?

Signs & symptoms dehydration

- Thirsty
- Fatigue, headache, dry mouth
- Loss of appetite, nausea
- Flushed skin, overheated
- Dizzy, weak
- Dark urine

Effects of dehydration

- Increased heart rate and body temp
- Decreased sweat rate
- Exercise seems harder
- ***Delayed stomach emptying of fluids***
- Decreased mental concentration



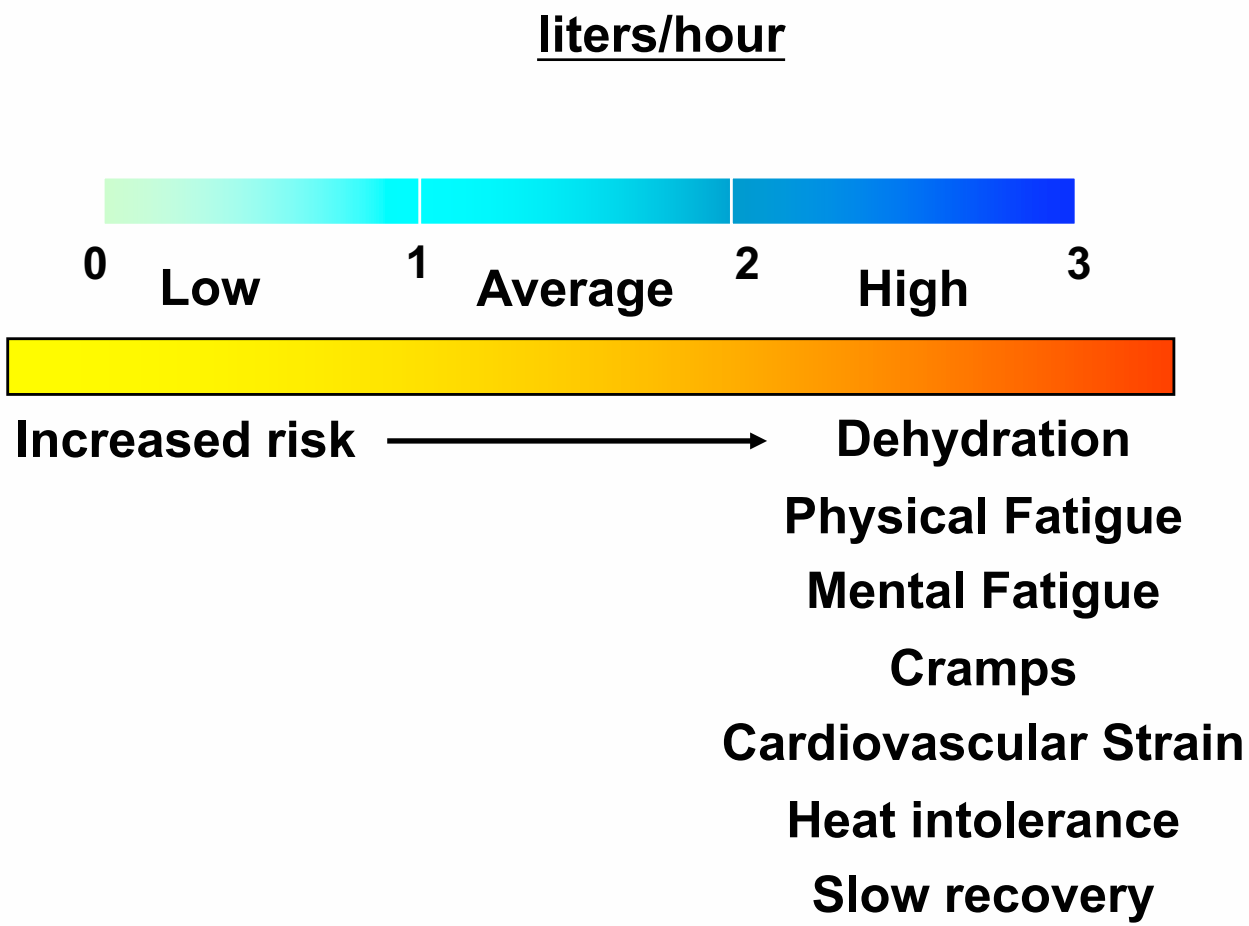
- **Double-check hydration status throughout the day by checking the color of urine**

- **Well-hydrated = Looks like *lemonade* (light in color)**

- **Dehydrated = Produces less urine than normal, and it's darker, like *apple juice***

Typical sweat losses

- Sweat rates vary from one athlete to the next
- Typical sweat losses can range from 0.5 – 3 liters per hour.
- Sweat losses add up over long races
- Acclimatization increases sweat rate



How much to drink?

Hydration plan for individual needs

Minimize loss of body weight without overdrinking

Check weight before and after workouts to determine your individual, average sweat rate:

(Pre-Weight – Post-Weight)
+
Fluid Intake During Activity
=
Individual Sweat Rate

Cheuvront, SN et al. 2002. *Med Sci Sport Exerc* 34 (8): 1344-1350

During exercise

Example

During a 1-hour workout
Pre-Weight: 68 kg
Post Weight: 67 kg
Fluid Intake: 720 ml of sports drink

(68-67 kg) ≈ 1000 ml of fluid lost
+
720 ml of fluid consumed
=
1720 ml of sweat loss per hour

Drink to match your sweat rate!

In this example, drink 8 ounces of fluid every 15 minutes

Sodium needs of athletes

- During long distance events sodium and other electrolyte losses are a consideration:

	Typical Athletic Occasion	Longer, More Intense Athletic Occasion
Workout, h	1	3
Sweat loss, l	1	4
Calories burned	600	1,800
Sodium loss, mg	1,150	3,220
Potassium loss	390	940
Magnesium loss	48	97
Calcium loss	120	240

Hyponatremia risk factors

- Drinking too much before and during prolonged exercise- water overload.
- Heavy salty sweaters more likely at risk - - many heavy sweaters get a "cake sweat" on their body during their long and intense runs
- Can also be both dehydrated and hyponatremic over longer distances

Hydration

- Caffeine does not increase fluid losses
- Alcohol
  - Does increase fluid losses
  - Turns off anti-diuretic hormone
- Sweat rate increases as athletes become fitter
- Athletes acclimatize when training in the heat and sweat rate increases

GI problems

- Greater in female athletes
- Sports that cause "joggling" of body
- High intensity exercise
- Lack of training
- Dehydration
- Ingestion fiber, lactose, fat
- Underlying GI problems

GI problems in endurance events

- 221 athletes: Assessed CHO Intake & 12 GI symptoms
  - IM and 70.3: 62-71 g/hr- 31% symptoms
  - Cycling (100, 150 km): 53 g/hr- 4% symptoms
  - Marathon: 35 g/hr- 4% symptoms
  - Pro-cyclists: 64 g/hr- 7% symptoms
- More trained- less GI distress
- More Carbohydrate-
  - more risk nausea , but also faster times

Pfeiffer, B et al. MSSE. 2012; 44(2): 344-351.

GI problems in endurance events

Reported GI symptoms during races were linked to a reported history GI distress

Can work with sports dietitian/nutritionist that can provide daily nutrition plan to control GI distress and develop a race nutrition plan

- IBS, Food Sensitivities, Other intolerances

Muscle cramping

- Linked to high sodium sweat losses
- Prolonged sweating in hot weather training
- Often can prevent with:
  - fluid replacement
  - sodium replacement
    - high sodium sports drink
    - salt tablets ore electrolyte mixes

Personalized plan: Practice!

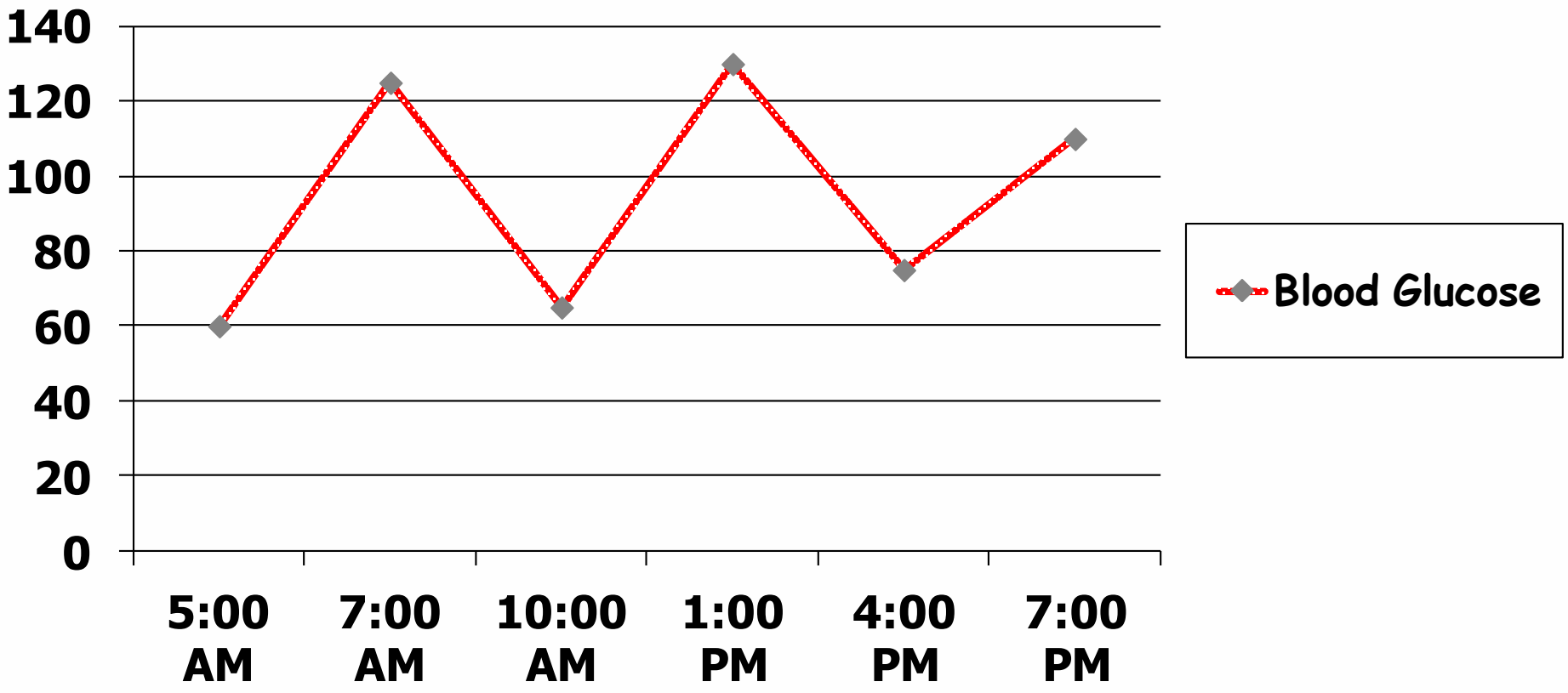
- Check sweat rate at various times in season
- Determine energy needs per hour
  - Increases with training/competition duration
  - Proper carbohydrate mix
- Salty sweater? 230-690 mg sodium/L
  - 1,000 mg per hour good target
  - High sodium sports drink, electrolyte mix, tablets

Fuel up and hydrate adequately before training or competition

Fueling before exercise

- Well hydrated for training
- Refill liver glycogen stores
- Top off muscle glycogen stores
- Provide fuel early part exercise
- Prevent hunger during exercise
- Psychological edge

Liver glycogen depletion



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Fueling over the pre-competition 3-4 hour window

Large pre-exercise meal 3-3.5 hours before

Fuel and hydrate up to the start

- Pre-competition
- Early am 3 hours prior
  - Oatmeal, juice, banana
- Hydrate with sports drink
  - 24-32 ounces, urine pale
- 90 minutes before
  - Small energy bar or liquid supplement
- 15-30 minutes: liquid shot

Low glycemic?

- Majority of studies measured no performance differences between Low GI and High GI meals
- Most did not provide fuel during exercise test
- If CHO consumed during exercise- type of pre-exercise CHO does not matter
- No CHO during exercise/event- try to add in low GI foods for more sustained CHO release

Nutrition within 1 hour of exercise

- Concerns about ingesting high GI foods within the hour before exercise
  - Increase in blood glucose and insulin levels
  - Fall in blood glucose at start of exercise (hypoglycaemia)
  - Increased use of CHO during exercise
  - Decreased use of fat as a fuel during exercise

Nutrition within 1 hour of exercise

Considerations:

- No evidence to show reduced performance following pre-exercise CHO
- CHO <u>should</u> be consumed during prolonged sessions – this overrides potential negative effects of pre-exercise eating
- Some athletes are susceptible to rebound hypoglycaemia – experiment in training

Nutrition within 1 hour of exercise

If athlete affected

- Experiment to find the best timing of pre-exercise eating
- If eating close to exercise, choose a snack that contains at least 70g CHO
- Include some low GI foods in pre-exercise meal
- Consume carbohydrate during long sessions

Carbo-loading (>90 minutes)

- Carbo-loading
  - 1-4 days ahead depending on event
  - Can be gentle over a few days
  - High intake carbohydrate 1-2 days before
    - Don't stuff day before
    - Finish eating early evening for early morning start

- 5 to 10 g/kg daily + decreased exercise
- 400-700 g CHO/day
- Supplements, liquids, concentrated carbs

GI Issues?

- Well practiced race plan
- Carbo-load 1-4 days, start early so you can "go easy" the day before competition
- No novel foods
- Keep it low in fiber in days before
- Reducing intensity may be the only way to control symptoms during competition

Multiple events

- Provide a fueling plan for game/tournament/meet that provides pre-competition meal and tolerated fueling and refueling between competitive efforts
- Aim for 30 g carbohydrate per hour if limited time between events
- Higher CHO, but easily digested, if more time between events

Protein Requirements

Based on:

- Small contribution protein to muscle fuel
- Build new muscle
- Repair damaged muscle

Protein Requirements

- High protein diets-weight sensitive athletes
- "Paleo" diet high in protein

Athletes with high energy needs consume plenty protein

Very high protein intake may crowd out needed carbs and fats

Timing of protein intake is really the key for recovery and muscle repair and rebuilding

Protein

- Easily consume adequate protein, unless:
  - many dislikes
  - uneducated vegetarian
  - restrictive eating

- Perceive themselves as requiring very high amounts
  - common belief in sport
  - large protein portions pervasive in our culture
  - also obtain protein from plant foods: grains, beans, vegetables that contribute to total protein intake

What are the best ways to get protein in foods?

Food	Protein content (grams)
5 oz. chicken breast (one half)	42 g
4 oz. lean sirloin steak	34 g
4 oz. turkey slices	25 g
1 cup mixed nuts	23 g
1 large hamburger	22 g
4 ounces tofu	20 g
1 cup dried beans	17 g
2 cups skim milk	16 g
2 eggs	12 g
2 Tbsp. peanut butter	8 g
1 oz. cheese	7 g

Protein Adds Up Easily- 140 g

1.5 cups cereal, 1 cup milk	16
1 banana and 1 tbsp. raisins	2
Energy bar	8
Sandwich, 4 oz turkey, 1 oz cheese	40
1 cup lentil soup	10
8 ounces yogurt	8
1 c. carrots	1
6 ounces chicken	48
1 large sweet potato	4
1 cup green beans	2
1 whole grain roll	2
	141g

Building Muscle

Balance between muscle protein synthesis (MPS) and muscle protein breakdown (MPD)

Protein synthesis

Most important factors:

- Daily protein intake
- Timing of specific protein doses
- Form and type of protein consumed

MPS is variable throughout the day on a meal-to-meal basis and augmented immediately and for a prolonged period after resistive exercise

Protein synthesis

Other factors:

- Calories required to build muscle
- Enough carbohydrates to meet fuel demands of resistance training and other workouts

When and what?

Providing protein after resistance training optimal for muscle protein synthesis (MPS)

- 20 g protein (8.6 g EAA)in hour *after*
  - *No dose response between 20 and 40 g in young men*
    - *Moore, et al. 2009, Am J Clin Nutr 89(1):161-8*
- High quality sources: BCAA particularly leucine regulates protein synthesis
- Combine with 35 to 50 g carbohydrate
  - More carbs if combined with another session

What and when

- 40 g whey protein (16.8 g EAA) maximally stimulates MPS after resistance exercise in older men (71 yrs)
  - Yang et al, Br J Nutr, Feb 2012
- 35 g whey protein resulted in greater MPS in older men(74 yr) compared with 10 or 20 g protein
  - Pennings, B et al. Am J Physiol Endocrinol Metab 2012

When

- One study found that 6 g EAA + 35 g sucrose ingested prior to exercise ingested prior to exercise was even more effective in stimulating MPS than immediately after
- Subsequent study failed to confirm these findings when ingested 20 g whey one hour prior
- May still be an effective feeding strategy for AA availability post exercise

Types protein

- Whey: "Fast" protein, all essential, rich source BCAAs- most potent in fed state and following exercise, *high in leucine*
- Casein: "Slow" protein that prevents muscle breakdown
- Soy: vegetarian, "fast" protein, not as effective as milk protein
- Milk Protein: 80% Casein, 20% Whey

Optimal Dose

- Following resistance exercise and possibly endurance exercise
  - 0.25-0.30 g protein/kg BM/meal when consuming isolated proteins
  - Leucine key stimulating MPS and key ingredient whey protein

S. Phillips. 2014 Sports Med 44 (Suppl 1): S71-S77

Form Protein

- Older adults achieved higher blood AA when consuming a protein containing beverage vs. bar

  Conley, TB et al, Br J Nutr, 2011, 106(2):203-7.

- Liquid forms protein peaked twice as quickly as solid protein foods
- Skim milk achieved faster peak leucine concentration than all other foods – about 25 minutes
  - Soymilk, beefsteak, boiled egg, liquid meal supplement

    Burke LM et al, IJSNEM, 2012, 22: 452-462

Muscle building over 24 hours

- 4 equally spaced protein containing meals/d
  - 0.25-0.3 g protein/kg/meal
  - 1 pre-sleep meal at 0.6 /kg/meal
  - 1.2 to 1.8 g/kg/day total for strength trained athlete

- For 80 kg team sport athlete
  - 4 X24 g + 1 X48 g = 144 g total
  - 1.8 g/kg/day

Require Dietary Fat

- Essential fatty acids
- Fat soluble vitamins
- Minimum 20-40 g day
- Many athletes need and consume more

Type of Fat

- Unsaturated vs saturated and trans fats
- Unsaturated fats
  - Beneficial for immune and inflammatory diseases, heart health benefits
- Omega-6 vs omega-3 fatty acids
  - Structural competitors inflammation
  - Diet heavily skewed to omega-6
  - Need more omega-3s

Sources of Fat

Omega-6 family:

- Oils: safflower, sunflower, corn, soybean, walnut, wheat germ, grape seed, nuts, grains, seeds

Omega-3 family:

- Fish/fish oil, flaxseed, pumpkin seeds, Canola oil, green leafy vegetables, walnut, soybean, legumes

Omega-9 family

- Olive oil

Inadequate Fat

- May not meet energy demands growth and development
- Essential fatty acid insufficiency
- Menstrual dysfunction
- Low testosterone
- Increased risk infection
- Cravings and hunger

Athlete Perception

- Dietary fat means body fat
- Quick and easy means for decreasing calories
- Many appreciate that excess body fat reflects caloric imbalance

Body fat stores

- Carbohydrate stores limited in size and highly dependent on daily diet
- Body fat stores in plenty supply in even lean athletes
- Can we make athletes more adept at burning body fat for fuel during training by adapting them to high fat diets?

Fat Requirements

Relevance to athlete:

- Replenishment of intramuscular triglycerides (endurance athlete)

Fat Requirements

Relevance to endurance athlete:

- Replenishment of muscle fat
  - Training greater than 4 hours
- Replete in 24-48 hours
  - 0.5 g/lb. body weight
  - Important during heavy training cycle

Fat Requirements

- 7 trained cyclists, 3 week study
- 2 hours exercise daily at 70% VO2 max
- 4400 calories daily and 32% energy from fat
- Week 2 and 3: randomly assigned 2% or 22% fat
- Metabolism studied at 67% VO2 max in fasted state

Coyle, E et al. Am J Physiol Endo Met, 2001, 280: E391-398

Fat Requirements

- IMTG significantly reduced on 2% fat
- Raised muscle glycogen
- 2% fat (and high carbohydrate diet) lowered whole body lipolysis, total fat oxidation, and nonplasma fatty acid oxidation and a reduced concentration of IMTG
- Raising fat from 22% to 32% fat did not increase IMTG
- Need more research

Fat Burning During Exercise

Series studies at Australian Institute Sport:

- Short-term high fat diet, 3-5 days
- CHO load 48 hours prior competition
- Time trial performance test

Burke, LM et al, 2000, JAP, 89: 2413-2421
Burke, LM et al, 2002, MSSE, 34: 1492-1498

Fat Burning During Exercise

Initial Study:

- 5 days on high fat vs. high CHO
- Day 6: rest + CHO load
- Day 7: Performance test in fasted state
- CHO loading restored glycogen
- More fat burning on fat diet
- No performance improvement

Fat Burning During Exercise

2nd Study:

- Similar to 1st study
- Consumed high CHO pre-exercise meal
- Still more fat burning after fat-loading
- No performance advantage

- ***3rd Study: Ultraendurance exercise***
- Trend toward improvement
- Responders and non-responders

Fat Burning During Exercise

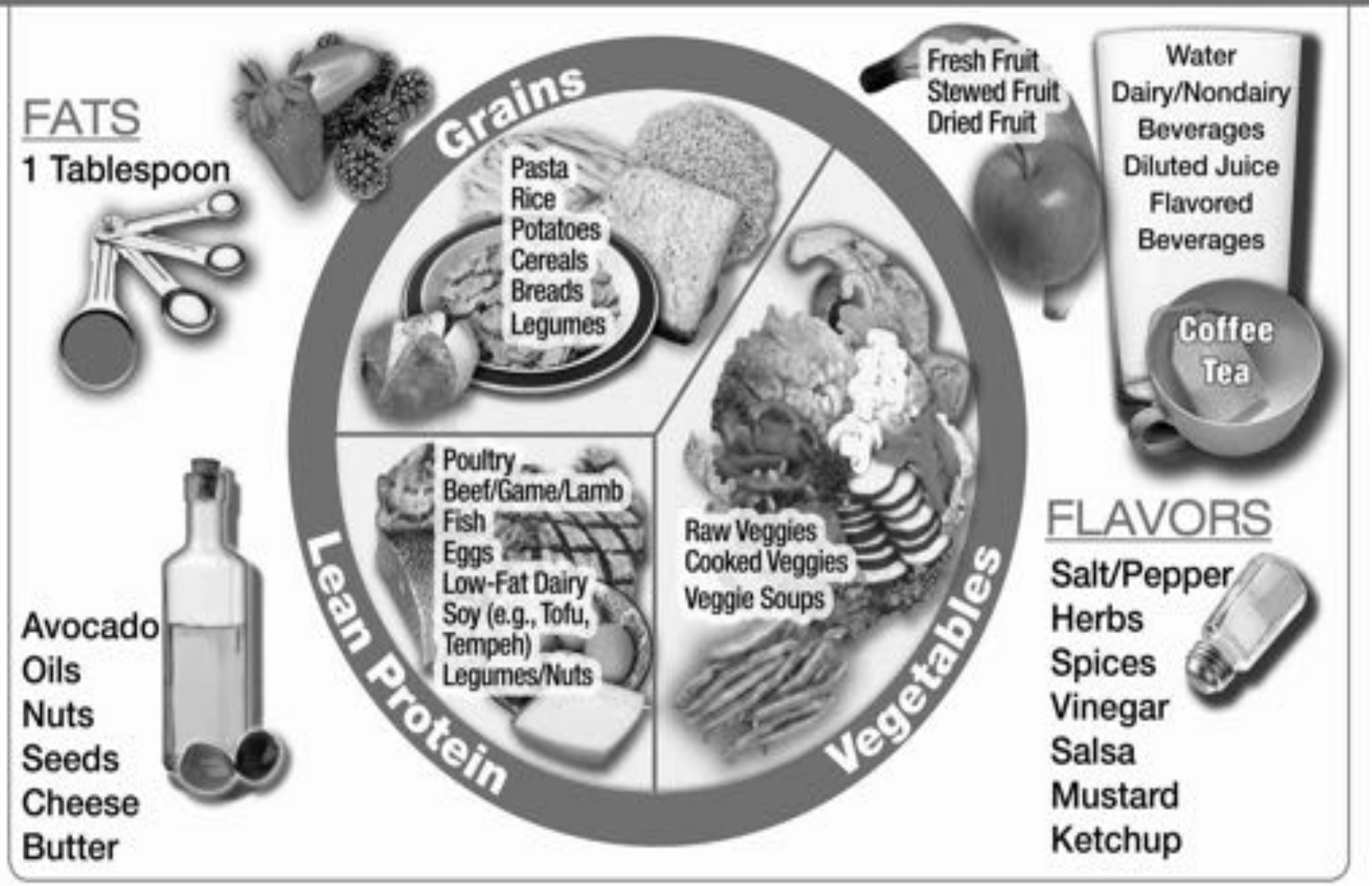
- Same fat adaptation and carbohydrate restoration model as AIS studies
- Used lab based 100 km TT that included self-pacing , high intensity bouts, moderate intensity segments
- No change in race outcome
- Cyclists not able to complete 1 km sprints at as high intensity
- Maybe for prolonged work at low intensities?

Periodize nutrition

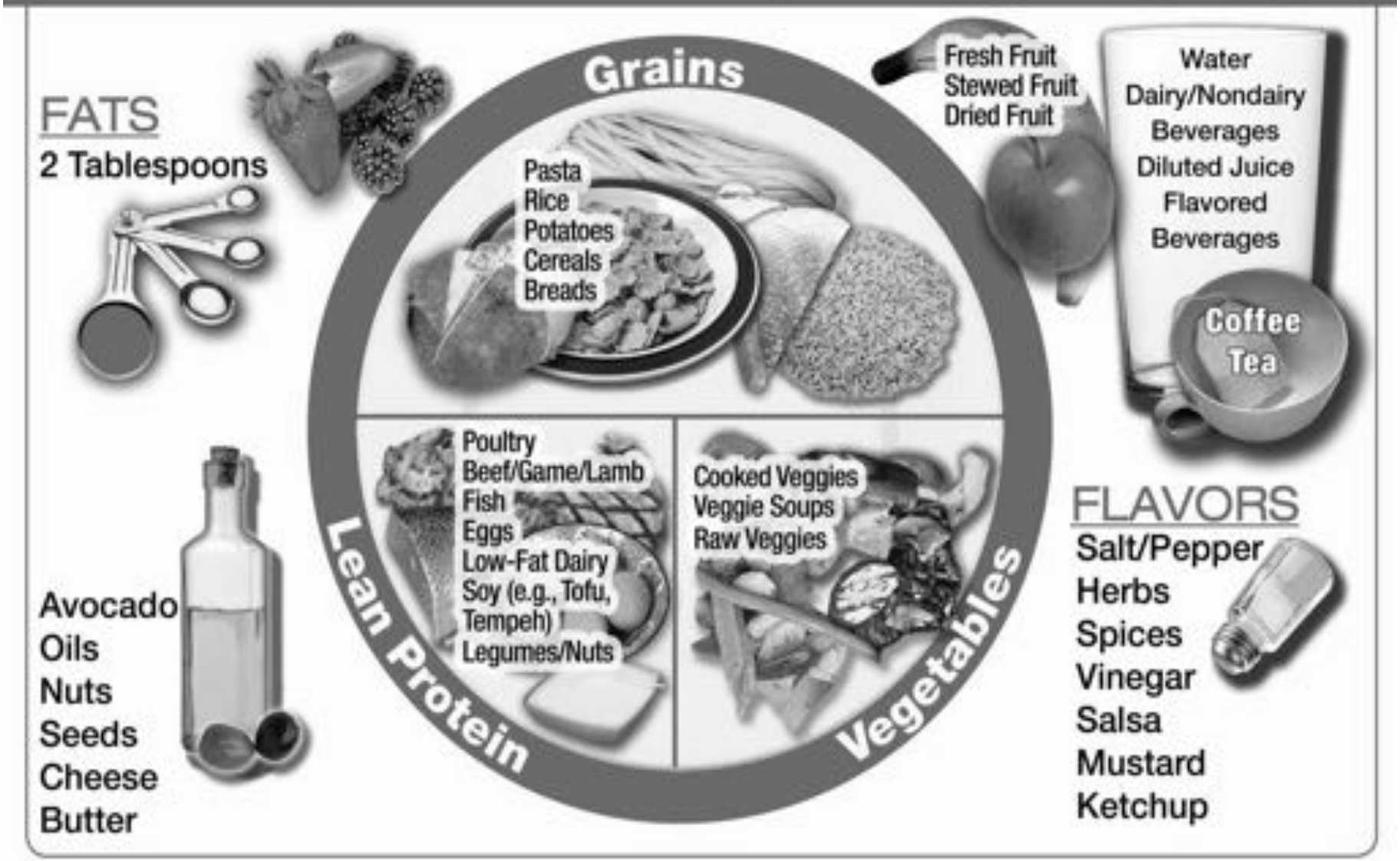
- Athletes periodize their training
  - Need to adjust intake at various times in season
  - May not follow all the guidelines all season
  - Reduce intake during non-key training for weight control
  - Optimize their nutrition support for key training sessions

The Athlete's Plates are a collaboration between the United States Olympic Committee Sport Dietitians and the University of Colorado (UCCS) Sport Nutrition Graduate Program.

MODERATE TRAINING:



HARD TRAINING / RACE DAY:



Case studies in applied sports nutrition

Swimming

Demanding swim workouts
Early am workouts and pm workouts
2-daily workouts
Dry-land training
Short races
Multiple events at meets
Day long meets with travel, warm-up, competition for all events

Male swimmer

- Estimated energy needs: 5,000 calories
  - Growth and development
  - Muscle building
  - Two-a-day training sessions
  - Dry-land training 3 days weekly
- Carbohydrate: 750 g daily includes daily and training diet
- Protein: 2 g/kg (easily met)
- Remainder calories from fat

Male swimmer

Reason for consultation

- Improve diet to improve swimming workouts and race times
- Prepare for important meets in 6 months
- Manage hunger

Profile

- Sophomore in HS: 15 yr
  - Ht: 6"0', Wt: 170 lb.
- Freshman (prior year)
  - Ht: 5'10", Wt: 145 lb.
- No health concerns, no medications, no nutritional supplements or food allergies/sensitivities

Male swimmer

Assessment:

- Still growing and developing
- 3 meals, 3 snacks
- Consuming ~3100 calories
- Adequate protein intake
- Inadequate carbohydrate for training and recovery
- Eating before workouts
- Can tolerate food close to training
- Uses sports drink during training
- Frequent hunger
- Not many concentrated carbohydrates
- No grains at family dinner
- Training twice daily for club schedule

Male swimmer

Follow-up in 6 weeks

- Adjusted meal plan for school swimming schedule
- Maintaining current weight

6 weeks into school season

- Mid-season times:
  - 100 m breast stroke- from 58:75 to 57:73
  - 100 m freestyle- from 49:74 to 47:32
  - Meets w/o full taper

Male swimmer

Initial consult

- Training Plan:
  - 5,000 calories, 750 g carbohydrate, 150 g protein, 155 g fat
- Specific plan: before am training, during am training, breakfast, snack, lunch, snack, dinner, late evening training, during swim, late snack
- Specific portions for food groups at each meal and snack
- Sports drink and or gels during both workouts
  - Specific carbohydrate amounts
- Protein timing for weight training and muscle building
- Daily hydration

Male swimmer

Follow-up in 2 weeks

- Weight increased from 170 to 176 lb.
- More energy, improved recovery
- Mom reports mood is better
- Working hard to get all food in and tolerating well
- Provided more meal and snack ideas
- Outline of foods and fluids, portion, and timing for meets
  - 3 to 4 races usually one hour apart
  - Pre-meet meal(s) and between races, recovery nutrition

Female swimmer

Reason for consultation

- Improve swim speed and endurance with optimal foods for training
- Decrease weight by 10 lb.

Profile

- Junior in HS: 16 years
- Ht: 5'3", Wt: 160 lb.
- No health concerns, medications, nutritional supplements or food allergies/sensitivities
- Menarche age 12
- Menstruates approx. every 60 days

Female swimmer

Assessment

- Usual intake 1500 calories daily
- Reports that she and mom have tried various diet strategies
- Salad at lunch
- No grains at dinner
- No sports drinks or other products during training
- No fuel before or during am practice

- Relative energy deficiency in sport

- Serum ferritin 22.4
- Hgb 14.4
- Hct: 42.8
- Vitamin D 46.6
- Poor calcium intake

Female swimmer

- Energy needs estimated at 3,000 calories daily for 2-a-day workouts
- 450 g carbohydrate, 150 g protein, 65 g fat
- Specific plan
- Can't eat early am before swim, so consumes gels or blocks or chews with water during workout
- Can also try sports drink
- Calories/carbs during am swim, B, L, D, pre-swim, during pm swim, post swim

Female swimmer

- Educated on Female Triad/RED-S and dangers of inadequate energy intake and dieting in relation to energy efficiency and affects on metabolism
- Adequate calcium from diet
  - Educated on calcium food sources
- Vitamin D 1,000 IU daily
- Ferrous glycinate 28 mg daily
  - Educated on iron food sources
- Educated on proper use carbohydrate-electrolyte beverage

Female swimmer

Follow-up in one month

- Doing well on plan; likes having more food
- More food, more energy, quality training
- Weight went from 160 lb to 152-154 lb.
- Developed competition day fuel and hydration plan
- Pre-swim/warm-up and between swims
  - 150 g carbohydrate at breakfast
  - 15-30 g carbohydrate per hour

Cross-country runner

Reason for consultation

- Running out of fuel the last mile of a 3 mile race
- Several weeks before state meet
- Wants fueling plan for training

- Ht: 5'8" Wt: 116-118 lb.
- BMI: 17 Age: 16 yrs
- Hgb 13.7 Ferritin 20
- 2 menstrual periods in past 4 months
- Regular "off-season"
- 75-90 minutes intense training 6 days per week

Cross-country runner

Assessment

- Intake estimated at 2200 calories, 240 g carbohydrate daily
- Was aiming for 2500 calories and 390 g carbohydrate
- Open to increasing weight/BMI
- Lactose intolerance; no milk or yogurt intake, consumes some cheese

Recommendations

- 2700-2900 calories, 400-430 g carbohydrate
- Specific meal plan for training days, sample menus
- More pre-exercise carbohydrate intake
- Lactose free dairy products for calcium
- Increase iron intake
- Ferrous bisglycinate supplement

Cross-country runner

Follow-up in 6 months

- Medaled at state meet prior Fall
- More energy, improved recovery during training
- Extra push at end race
- Menstruation regular; tolerating iron
- Ht: 5'8.5", 120 lb. , BMI 18.4
- Goal: 124-125lb. BMI 19
- Adjusted nutrition plans for current training and weight goals-3300 calories

Cross-country Runner

- Next Fall Season
- Hard Training Program
- Maintained 120 lb. on 3,300 calories daily
- Ate five times daily
- Menstruation regular except for one missed period during season

Professional soccer player

- 35 year old male, midfielder
- Ht: 6′, Wt: 185-190 lb. (84-86 kg)
- High sweat rate
- Busy player on field
- Muscle cramping at games
- Morning practice
- Coaches in evenings

Demands of the game

- Anaerobic: 4-5 sec all-out bursts
- Aerobic: 30 seconds walking or jogging
- Change pace or direction frequently
- Cover 3 to 7 miles per game
- Midfielders cover the most distance and are the most active
- Skill oriented and high level conditioning

Typical intake day

Pre-practice:

- cereal,-2-3 cups, milk, sugar

Practice, 2.5 hours:

- water + banana

Post practice:

- bagel, banana, juice

Lunch:

- Had been skipping
- added in 2 weeks ago
- Sandwich and pretzels

Coaching in evening

- Hydrates with water

Dinner:

- high carbohydrate
- eating out

Considerations

- Easily digested breakfast pre-training
- Carbohydrate and fluid replacement during training with carbohydrate-electrolyte beverage
- Improved recovery nutrition
  - immediately post-training-products available
  - Again 2 hours after training- lunch
- Snacking to meet energy needs during coaching
- Prepare simple dinner meals with moderate protein and ample carbohydrate

Meal planning

Breakfast

- Cereal, milk, juice, fruit
- 620 calories, 115 g CHO
- Add in protein source when resistance training

Recovery Nutrition

- Large bagel, recovery shake with 20 g protein, banana
- 90 g CHO, 30 g PRO

Lunch

- Turkey sandwich, 1.5 ounces pretzels, Juice, 12 ounces

Coaching-

- Energy bar, fruit, fluid

Dinner

- Review proper CHO portions, moderate amounts protein

During practice

- Replace fluid and carbohydrate losses
- Pre-hydrate with sports drink
- Sports drink at breaks
- Higher sodium sports drink?
  - 200 mg sodium per 8 ounces
  - Sodium tablets? May consider for games in hot and humid weather

Game Strategies

- Rest + carbo-load day before
- High sodium foods
- Pale urine indicates adequate hydration
- Time game day eating properly
  - afternoon or evening game
  - easily digested
  - top off meal with bar or gel in the hour before game

Game Strategies

- Hydrate when able during game
- Re-hydrate and refuel at half-time
- High sodium sports drink
- Other electrolyte replacement with tablets

Assessment

- Inadequate daily carbohydrate intake
  - Poorly fueled for practice
- Improve recovery nutrition
- Learn sweat rate for practice and games
  - Develop hydration, fuel replacement, and carbohydrate replacement plan

Requirements

Daily training requirements

- 4,000 calories (48 kcal/kg)
- 600-670 g carbohydrate (7-8 g/kg)
- 135-150 g protein (1.6-1.8 g/kg)
- 100 g fat to meet energy needs
- Sodium? Aim for over 600 mg per hour

Ironman: demands of the sport

Ironman Race:

- 2.4 mile swim
- 112 mile bike
- 26.2 mile run

- Finishing times
- <9 hours pros
- cut-off 17 hours

Half IM 70.3

- 1.2mile swim
- 56 mile bike
- 13.1 mile run

- Cut-off 8.5hours

Demands of the sport

- Train in 4 disciplines
  - includes resistance training
  - often two-disciplines daily
    - separate workouts
    - back to back
    - Long bike and long run weekly
  - recovery time: 4 hours, 8 hours, 12 hours, 24 hours

Female Ironman triathlete

- 45 yr. old female
- Training for Ironman
- Goals:
  - Fuel body training
  - Improve diet quality
  - Expand food choices

IM training

- Build long bike rides to 6 hours
- Build long runs to 3 hours
- High intensity workouts
- Training Cycles
  - Recovery weeks
  - Build weeks
  - Moderate weeks

Training: Key IM week

Monday:
Bike: 90 min easy
Run: 80 min int.
Wts: 30 min

Tuesday:
Swim: 75 min
Run: 40 min easy

Wednesday:
Bike: 90 min
Wts: 30 min

Thursday:
Bike: 300 min
Run: 45 min, t-run

Friday:
Swim: 75 min
Run: 120 min
Wts: 30 min

Sat: off

Sunday:
Swim: ½ mile
Bike: 12 miles
Run: 3 miles

Sprint Race

Carbohydrate: Match that day's training

Example

- 120 pound triathlete
- Recovery day: 300 g CHO
- Moderate day: 420 g CHO
- Hard day: >550 g CHO
- Rest day: 270 g CHO

Meal planning

- Meal plans designed to match training:
  - 2,500 to 3,800 calories daily
  - match carbohydrate to training
    - 360 to 550 g
  - adequate protein in build phase
    - 1.8 g/kg- easily met in diet
  - replenish fat stores after >4 hours training
    - 1 g/kg body weight

Fueling Plan

- Check sweat rate on the bike and during the run
- Recheck during season
- Start with sports drink that is 6% concentration
- Replace sweat losses
- Where does the carbohydrate fall?
- 70 g/hr in 32 ounces or 1liter is 7% concentration
- 32 ounces or 1 liter sweat per hour
- Results in 56 g carbohydrate per hour
- 40 ounce or 1.2 liters results in 70 g per hour
- 40 ounces per hour can be challenging
- More concentrated drink? Add in gels?

Fueling Plan

- Start aiming for 24 ounces per hour
- Increase tolerance to 32 ounces per hour
- Practice!
- Assess tolerance of 8% mix
- Higher sodium sports drink
- Assess need for gels to add carbohydrate-more concentrated source – assess tolerance and consume with water/electrolytes

Fueling Plan

- Created a flow sheet plan of what to consume per hour on the bike and run
- Fueling at T1 and T2 is an option
- Different tolerances on run
- Need to use products on course
- Can carry own gels
- May carry salt tablets as well

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